

Embedded and Hybrid Systems (EHS)

Program Announcement

NSF-01-161

DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING
DIVISION OF COMPUTER-COMMUNICATIONS RESEARCH

FULL PROPOSAL DEADLINE(S) :

December 5, 2001; and first Wednesday of December annually thereafter.



NATIONAL SCIENCE FOUNDATION



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SUMMARY OF PROGRAM REQUIREMENTS

GENERAL INFORMATION

Program Title: Embedded and Hybrid Systems (EHS)

Synopsis of Program: The EHS program supports research in scientific principles and technology to revolutionize the design and development of embedded systems for a broad range of applications. Software has enabled increasingly ambitious, often safety-critical, systems (e.g., transportation, manufacturing, medical devices and systems, environmental control, and energy management). These include distributed and coordinated embedded systems, demanding high levels of autonomy, adaptation, and component integration (e.g., multi-modal sensing and control). Embedded systems combine interacting elements: temporal, spatial, and physical properties and the continuous dynamics of the system to be monitored or controlled; the timing and synchrony properties and resource demands of software that controls the system; and the characteristics and services of the computational platform (both systems software and hardware). The goal of the EHS program is to create and unify the foundations for managing interacting physical and computational systems and to supply the technologies needed for building reliable software- and network-enabled embedded systems. The program draws on control theory, modeling, software generation, real-time software systems, and formal methods. Relevant research includes areas such as: hybrid (discrete and continuous) modeling and control of physical systems; domain-specific design, programming, and software synthesis approaches for embedded systems; verification and analysis technology for checking and certifying correct operation of embedded software and systems; real-time open systems, middleware, and virtual machine strategies for embedded systems; dynamic scheduling that accommodates both hard and soft real-time processes; and program composition approaches for synthesizing software while preserving essential properties.

Cognizant Program Officer(s):

- Dr. Helen Gill, Embedded and Hybrid Systems, Program Director, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: hgill@nsf.gov.
- Ms. Carmen Whitson, Associate Program Director, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: cwhitson@nsf.gov.

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.070 --- Computer and Information Science and Engineering

ELIGIBILITY INFORMATION

- **Organization Limit:** None
- **PI Eligibility Limit:** None
- **Limit on Number of Proposals:** None

AWARD INFORMATION

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 20-25
- **Anticipated Funding Amount:** Subject to the availability of funds, the anticipated funding for FY 2002 will be between \$4Million - \$6Million. Subject to availability of funds, it is anticipated that future year funding will be approximately the same.

PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

- **Full Proposals:** Supplemental Preparation Guidelines
 - The program announcement/solicitation contains supplements to the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full program announcement/solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

C. Deadline/Target Dates

- **Letters of Intent (*optional*):** None
- **Preliminary Proposals (*optional*):** None
- **Full Proposal Deadline Date(s):**

December 5, 2001; and first Wednesday of December annually thereafter.

D. FastLane Requirements

- **FastLane Submission:** Required
- **FastLane Contact(s):**
 - Ms. Sharon Glivens, Program & Tech Specialist, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: sglivens@nsf.gov.

PROPOSAL REVIEW INFORMATION

- **Merit Review Criteria:** National Science Board approved criteria apply.

AWARD ADMINISTRATION INFORMATION

- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

I. INTRODUCTION

Past research in embedded systems has focused primarily on resource-impoverished computational environments: algorithms and software that must execute on memory-, processing-, and power-constrained processors. The computational design was simple and synchronous to maximize effective operating rates, and a great deal of design effort went into optimizing performance under these conditions. As processing speed and data capacity have increased and demands for automation have expanded, the nature of the problem has changed. Now, hard and soft real-time processes must interact, and they may be required to share the same resources. Applications such as distributed control demand communication, which introduces variability in operation. A scientific foundation currently is lacking for systematic development and integration of physical and computational components in embedded systems. This lack is particularly severe for increasingly complex, distributed embedded systems. Empirical reports show that relying on brute-force testing for verification and validation of software for modern embedded systems can push certification costs to at least half the total cost of the software. Scientific principles and supporting technology are needed to assure that requirements are met during development of software-based systems, in order to reduce the cost of evaluating dependability and certifying that a system is fit for operation. NSF investment is critical to sustain, adapt, and expand the National research and development capacity in embedded systems.

II. PROGRAM DESCRIPTION

This program supports fundamental research in embedded systems, emphasizing the role of information technology, specifically embedded software, as an active element in control, diagnosis, and decision support for physical and engineered systems. Embedded systems combine interacting elements: 1) the temporal-spatial properties and continuous dynamics of the physical system to be monitored or controlled; 2) the concurrency, real-time, and synchronization properties and resource demands of software that controls the system; and 3) characteristics and services of the computational platform (both hardware and system software). This program seeks a foundation for systematic integration of these elements. The application of software-centric, embedded systems is increasingly ambitious, including not only such traditional concerns as resource-bounded software for small systems such as cellular phones and embedded sensors, but also highly automated and safety-critical, engineered systems. Historically, control and software have been treated as separate, isolated disciplines. This program encourages a unified approach to software-enabled information and control technologies for embedded autonomous or semiautonomous systems of all scales, including complex adaptive systems and multi-systems. The program seeks better understanding of hybrid systems that entail both discrete (logical) and continuous (physical) components and behavior. The goal is a foundation for rigorous design, development, and execution of embedded software in automotive and other transportation systems, manufacturing, medical devices and systems, environmental monitoring and control, power management, and similar applications.

Areas

The Embedded and Hybrid Systems program currently emphasizes the four areas described below. Although these areas are described separately, their concerns are highly interdependent. Proposers are encouraged to identify all areas upon which significant emphasis will be placed and explain how the planned research in each will interface with the other areas.

Embedded Software Composition. This area focuses on software synthesis, programming, and runtime technologies for embedded systems. Previously, embedded software has been realized as statically designed cyclic executives, implemented as fixed, nested loops that are inflexible and difficult to modify. The goal is to replace the closed, monolithic, and fragile design of previous embedded systems with a robust foundation for open embedded systems, including support for real-time, fault-tolerant, reactive, synchronous, and time-triggered software properties, as well as multi-threaded, actor- or object-oriented embedded systems languages and runtime services.

This area includes research in property-oriented or aspect-oriented programming for embedded systems, emphasizing transformational methods, reusable patterns and middleware strategies, and model-based software analyses. The goal is to support efficient and rigorous composition of embedded systems software. This subprogram encourages research in topics that include application programming interfaces, runtime systems, and virtual machines for real-time programming; reusable open component technology (e.g., middleware and patterns); and software reconfiguration, thread and data management, and dynamic scheduling and resource management services. Approaches are needed for integrated reasoning about time, order, priority, and related topics in concurrency, and for managing synchronous and asynchronous operation of system components.

Hybrid Modeling and Control. This area supports research in software-based control of physical and engineered systems. This area seeks advances in hybrid systems. The goal is a design framework that can put physical systems, embedded control software, and computer hardware on a common semantic footing for modeling and design. Hybrid systems theory provides a unified mathematical framework for modeling the discrete (logical) operation of software as well as its continuous properties (e.g., spatial location, attitude, continuous time), the continuous and discrete models computed during operation, the discrete modal structure and continuous dynamics of the physical system, and the interactions of the combined computational and physical system. One important problem is the management and use of data models (both continuous and hybrid) in software-based predictive control systems. Among the issues are: theoretical foundations for reasoning about the continuous and discrete behaviors of systems, means for mapping these hybrid behaviors to software, and system software services needed to support hybrid controllers. This program area also emphasizes research in multi-modal, adaptive, reconfigurable, and coordinated systems.

Relevant topics include on-line and mixed on-line/off-line model-centric methods that can support adaptation and achieve improved robustness and dynamic performance, innovations in model abstraction or reduction (continuous-continuous, discrete-continuous, discrete-discrete), abstract interpretation, and the use of discrete and hybrid reasoning methods such as model-checking for high-performance predictive control. Research is also needed in foundations and implementation strategies for integration and coordination of distributed sensing and control. Validation of research is encouraged through experimental applications such as mechanical, chemical, propulsion, environmental, electrical, and biological or medical control systems.

Resource Management for Embedded Systems. This program area supports research in the management of physical and computational resources in embedded systems. It includes research in topics such as analytic redundancy in sensor systems and alternative and composite actuation strategies for over-actuated systems. It also includes innovative research in optimizing the use of computational resources such as processors, caches, and network bandwidth. The goal is not only performance improvement, but constraint satisfaction guarantees, as well. Research is encouraged in unified frameworks (such as Quality of Service) that support prediction and control of end-to-end real-time and capacity properties and that are applicable to both: off-line system design and on-line operation.

High Confidence Embedded Software and Systems. Methods are needed that reduce dependence on exhaustive testing to provide assurance that a system meets its requirements and is fail-safe. This program area supports research in technology-supported methods for building dependable embedded systems, emphasizing assurance-oriented technology for designing and synthesizing fault tolerant and robust systems. This research area includes topics in design methods and modeling that include: reasoning about uncertainty, scalable failures and effects propagation analysis, design completeness checks for system failure modes and effects, composition of physical and logical components at different levels of criticality, and spatial-temporal isolation strategies for assuring non-interference of critical functions. It also includes run-time software and control methods for fault tolerance, including dynamic failure detection, isolation and recovery.

Research is also included in technologies that help to reduce cost and increase effectiveness of complex system evaluation and certification. Relevant topics include augmenting system design and software composition frameworks to produce evidence useful for certification. For example, assumptions and guarantees used in design and implementation could be provided as evidence to support a safety case. Research is needed in engineering and certification frameworks that can support composition of evidence from different components of the system for reasoning about the full system

III. ELIGIBILITY INFORMATION

The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation. Proposals may be submitted by universities in support of individual investigators or small groups. Synergistic collaboration among researchers and collaboration or partnerships with industry or government laboratories are encouraged when appropriate. Group and collaborative proposals may involve more than one institution.

IV. AWARD INFORMATION

Approximately 20-25 awards are expected, with a duration of 2-5 years. Expected award amounts range from \$80,000-150,000 per year for single- and two-investigator proposals and \$100,000-500,000 per year for collaborative and multi-investigator proposals. Subject to the availability of funds, the anticipated funding for FY 2002 will be at least \$4 Million and up to \$6 Million. Subject to availability of funds, it is anticipated that for future year competitions funding will be approximately the same. Number of awards and average award size and duration are also subject to the availability of funds.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal:

Proposals submitted in response to this program announcement/solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF *Grant Proposal Guide* (GPG). The complete text of the GPG is available electronically on the NSF Web Site at: <http://www.nsf.gov/cgi-bin/getpub?gpg>. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from pubs@nsf.gov.

When group and collaborative proposals are submitted by more than one institution, each of the collaborative proposals must contain identical technical content and the budget only for the participating institution. The titles must also be identical and must begin with the prefix "Collaborative Research:". Each proposal must identify all participating institutions. Group and collaborative proposals may also be submitted as a single administrative package from one of the institutions involved.

Due to the limited availability of funds, prospective applicants are urged to contact one of the Program Officers listed at the end of this document for guidance.

Proposers are reminded to identify the program solicitation number (NSF-01-161) in the program announcement/solicitation block on the proposal Cover Sheet (NSF Form 1207). Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost sharing is not required in proposals submitted under this Program Announcement.

C. Deadline/Target Dates

Proposals must be submitted by the following date(s):

Full Proposals *by 5:00 PM local time:*

December 5, 2001; and first Wednesday of December annually thereafter.

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this Program Announcement through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: <http://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call 1-800-673-6188 or e-mail fastlane@nsf.gov.

Submission of Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see [Chapter II, Section C](#) of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane website at: <http://www.fastlane.nsf.gov>.

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

Proposals will be reviewed against the following general review criteria established by the National Science Board. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will be asked to address only those that are relevant to the proposal and for which he/she is qualified to make judgements.

What is the intellectual merit of the proposed activity?

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Principal Investigators should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to both of the above-described NSF merit review criteria. NSF staff will give these elements careful consideration in making funding decisions.

Integration of Research and Education

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A summary rating and accompanying narrative will be completed and signed by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Mail and/or panel review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 70 percent of proposals. The time interval begins on the date of receipt. The interval ends when the Division Director accepts the Program Officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at its own risk.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See section VI.A. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1)* or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Web site at http://www.nsf.gov/home/grants/grants_gac.htm. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Web site at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Web site at <http://www.gpo.gov>.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented an electronic project reporting system, available through FastLane. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding Embedded and Hybrid Systems should be made to:

- Dr. Helen Gill, Embedded and Hybrid Systems, Program Director, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: hgill@nsf.gov.
- Ms. Carmen Whitson, Associate Program Director, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: cwhitson@nsf.gov.

For questions related to the use of FastLane, contact:

- Ms. Sharon Glivens, Program & Tech Specialist, CISE, C-CR, 1145, telephone: 703-292-8910, e-mail: sglivens@nsf.gov.

IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF [E-Bulletin](#), which is updated daily on the NSF web site at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's [Custom News Service](#) (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Proposals concerning Embedded and Hybrid Systems research that are submitted to NSF-wide programs such as the Information Technology Research and CAREER programs, as well as those that can be considered for EPSCOR funding, should designate CISE/C-CR EHS as the related program area.

The CISE/EHS program operates in partnership with all other programs in CISE/C-CR and CISE/ANIR.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF (unless otherwise specified in the eligibility requirements for a particular program).

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the program announcement/solicitation for further information.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090, FIRS at 1-800-877-8339.

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PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

Pursuant to 5 CFR 1320.5(b), an agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Information Dissemination Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230, or to Office of Information and Regulatory Affairs of OMB, Attention: Desk Officer for National Science Foundation (3145-0058), 725 17th Street, N.W. Room 10235, Washington, D.C. 20503.

OMB control number: 3145-0058.